COMMONWEALTH OF MASSACHUSETTS
ENERGY FACILITIES SITING BOARD

Petition of Vineyard Wind LLC pursuant to G.L. c. 164, § 69J for Approval to Construct Transmission Facilities in Massachusetts for the Delivery of Energy from an Offshore Wind Energy Facility Located in Federal Waters to an NSTAR Electric Company (d/b/a Eversource Energy) Switching Station Located in the Town Of Barnstable, Massachusetts.	EFSB 17-05
Petition of Vineyard Wind LLC pursuant to G.L. c. 40, § 3 for Exemptions from the Operation of the Zoning Ordinances of the Town of Barnstable and the Zoning Bylaw of the Town of Yarmouth for the Construction and Operation of New Transmission Facilities in Massachusetts for the Delivery of Energy from an Offshore Wind Energy Facility Located in Federal Waters to an NSTAR Electric Company (d/b/a Eversource Energy) Switching Station Located in the Town of Town of Barnstable, Massachusetts	D.P.U. 18-18
Petition of Vineyard Wind LLC pursuant to G.L. c. 164, § 72 for Approval to Construct and use Transmission Facilities in Massachusetts for the Delivery of Energy from an Offshore Wind Energy Facility Located in Federal Waters to an NSTAR Electric Company (d/b/a) Eversource Energy) Switching Station Located in the Town of Barnstable, Massachusetts.	D.P.U. 18-19

COMMONWEALTH OF MASSACHUSETTS
ENERGY FACILITIES SITING BOARD
EFSB 17-05/D.P.U. 18-18; 18-19

DIRECT TESTIMONY OF ANN MARIE PETRICCA

Q. Please state your name, position, and employer.

A. Ann Marie Petricca, C.P.G., Director of Geosciences, Environmental Partners Group, Quincy, MA.

Q. On whose behalf are you testifying?

A. The Town of Barnstable.

Q. Please tell us about your education and professional background.

A. My resume is attached.

Q. What is the purpose of your testimony?

A. As a Certified Professional Geologist who is extremely familiar with the Hyannis Water System and the geology and hydrology at the site of the Company's proposed Independence Park substation, and because of my expertise in siting and permitting of public water supplies and the regulatory scheme controlling that process, I have been asked to examine this project and provide evidence to the Siting Board.

Q. Please describe the geologic history, the hydrology of the area, and the sole-source groundwater lens serving the Hyannis Water System.

A. Cape Cod was formed at the end of the Ice Age as a glacier melted. The melt outwash at its leading edge deposited sand, clay, and rock and formed what is now Cape Cod. The soils in the subject area are generally very sandy and porous.

The highest point of land on the Cape generally follows the mid-Cape highway from Sagamore to Orleans/Eastham and slopes gently to Nantucket Sound on the south and Cape Cod Bay on the north. The aquifer receives all of its water from precipitation. Ground water leaves the system as discharge into freshwater surface water bodies and saltwater bodies, and at wells. The groundwater from the Sagamore lens ultimately discharges to Cape Cod Bay to the northeast and Vineyard Sound to the south. Groundwater flows along those contours from the high point downward generally towards both bodies of water. Groundwater flows generally south and southeast in the vicinity of the Town's Mary Dunn wells, its Maher wells, and more southerly towards its Hyannis Port, Simmonds Pond, and Straightway wells. Based on nearby USGS Groundwater Watch well data, groundwater in the vicinity of the Company substation in Independence Park may be as shallow as 15-30 feet below the surface. However, no site specific depth to groundwater data is available for the Company substation in Independence Park.

Q. At the Town's request, you examined the MSDS sheets for dielectric fluids that NSTAR uses in its Independence Park substation and that Cape Wind would have used if it had built its substation there. What are the trade-names of those products and what warnings on their MSDS sheets are relevant to this matter?

A. The two products are Faridol and Edisol. Both are oil-based and are exemplars of dielectric fluids used in the industry to cool transformers and other high-voltage electric equipment. I am informed that Vineyard Wind will be using such a cooling fluid, although it has not been identified yet.

The MSDS sheet for Faridol indicates:

The MSDS for Section 6 states, "Environmental Precautions: Do not release into the environment. Do not let product enter drains. Dam up."

The MSDS for Benzyltoluene under Section 8 indicates under Risk Management Recommendations – Environment Protective Measures, "Do not allow contact with soil, surface or groundwater. Prevent leaks and prevent soil/water pollution caused by leaks.

Faridol contains 70-80% benzyltoluene. It has an estimated concentration of 20-30% dibenzyltoluene which has "strong absorption" mobility in soil (Section 12).

The MSDS for Dibenzyltoluene under Section 8, Risk Management Recommendations – Environment Protective Measures indicates, "Do not release into the environment. Do not let the product enter drains. Dam up. Provide a catch tank in a bunded area. Provide impermeable floor."

The MSDS sheet for Edisol indicates:

The MSDS for Edisol VI Section 12 states, "Do not allow product to reach groundwater …"
Section 6 states, "Prevent material from entering storm sewers, ditches, or drains that lead to waterways."

Section 2 identifies the substance classification as "Acute Tox 4".

Q. Based on the oil content and chemical makeup of Faridol and Edisol, are one or both listed by name or generically in the Massachusetts Contingency Plan and in ***Standards and Guidelines for Contaminants in Massachusetts Drinking Waters*** published by MADEP? If so, what is the reportable concentration in ground water serving public water supply above which a municipality must abandon such water supply?

A. The maximum allowed concentration of total petroleum hydrocarbons in drinking water or in a potential drinking water source area (Independence Park substation is located within the Zone II for the Town's public water supply wells) is 0.2 mg/L or 1:5,000,000.

Q. Vineyard Wind proposes to install four (4) large, ground-mounted transformers at the Independence Park site. Each will contain approximately 10,000 gallons of dielectric fluids. If a catastrophic event causes a full release of dielectric fluid from only one transformer and that fluid enters the ground water, how many gallons of water could potentially be rendered unusable?

A. The math is simple. 10,000 x 5,000,000 equals 50 Billion gallons of water which could be rendered undrinkable. A catastrophic failure of all four transformers would contaminate 200 Billion gallons of water.

Q. What is the most recent annual gallonage of water pumped in the Hyannis Water District and from the Mary Dunn Wellfield specifically?

A. The entire district pumped 517,000,000 gallons of water in 2017. The Mary Dunn Wells which are most at risk in this matter pumped about 196,000,000 gallons of water in 2017.

Q. Vineyard Wind has proposed a containment basin at its substation to capture any release of hazardous products. However, it has produced no plans for containment, has done no soil testing at the site of the substation, and has not identified the make of dielectric fluid, its chemical content, and its properties such as viscosity, permeability, solubility, or flammability. Without these parameters being disclosed, is it possible even begin to evaluate the risks posed at the site or the adequacy of mitigation and design to a reasonable scientific certainty? Explain fully.

A. Without any or all of those parameters identified with specificity, it is not possible to even begin to evaluate the risks posed or the mitigation necessary. Without scientific testing of the chosen dielectric fluid/s to determine how quickly they would percolate to the groundwater, how they would mix with groundwater on contact, and how quickly they would be transported to various town wellheads, it is impossible to assess risk and therefore impossible to evaluate response time and actions necessary to minimize the impact of a release.

Further, it is also impossible gage the adequacy of containment for at least two reasons. First, the containment vessel is apparently going to be made of concrete which is an inherently porous product. IEEE 980, the industry standard for substation containment, calls for impermeable blankets to be placed below the primary containment, i.e., the concrete structure. The chemical makeup and physical properties of the dielectric fluids must be lab-tested against the concrete and blanket substrate to determine whether the containment systems are actually impermeable to the chosen fluid.

As one example, studies related to the emerging contaminant 1,4-dioxane (which was historically used in laundry detergent and liquid dish soap) indicate that the release of 1,4-dioxane could penetrate a 1 meter thick compacted clay liner and result in groundwater concentrations that exceed drinking water guidelines. In groundwater 1,4-dioxane is extremely soluble, does not readily adhere to soils, and can migrate long distances. Not knowing the composition of the di-electric fluids proposed for the transformers at the Independence Park substation makes it impossible to adequately determine an appropriate containment system.

Secondly, the containment vessel needs to be designed with the ability to drain rainwater without allowing hazardous materials to pass through. A common product sold as "imbiber beads" is placed in drains and is designed to allow water to pass and drain but is also designed to immediately swell on contact with oil-based liquid and to completely block drainage. The imbiber beads must be lab-tested against all hazardous products at the substation to assure that it will react and function as advertised.

Q. Why is soil testing necessary?

A. In planning for worst case scenarios, it is vital to understand how quickly any or all of the hazardous products at the substation could migrate through the sandy, glacial soil directly below the substation to reach the groundwater. Exact depth to groundwater in the area of the Substation is not known for certain at this time.

With accurate lab test results, it is then possible to evaluate required response times and equipment, notification, and alarm protocols that must be in place or available to capture a hazardous release before it reaches groundwater.

Q. Other than modeling, is there site-specific testing data available to confirm direction of ground water flow below the substation, depth to groundwater, and rate of migration and time-to-impact wellheads in the event of release? Is this information critical to risk evaluation and mitigation plans? Explain.

A. It is vital that depth to groundwater, rate of flow, and direction of groundwater flow under various well pumping conditions be fully and accurately understood in real life application. Having this information will inform all interested parties of the wells most likely at risk from a hazardous product release and the time-to-impact nearby environmental receptors (groundwater supply wells or protected surface water bodies) in such an event. This information is vital to determine whether the Hyannis Water System can survive such an impact, how much, and for how long.

Q. What other critical variables are unknown at this point?

A. Certainly the ability or inability to filter impacted groundwater is a critical parameter. If the chosen dielectric fluid, for example, is highly or infinitely soluble in groundwater, extracting or filtering this product may be an exceptionally lengthy process, if not impossible. For example, an estimate ten-gallon cleaning product release at Cape Cod Potato Chips factory nearby several years ago shut down a Barnstable Water District well for over a decade.

Here, the MCP maximum allowed concentration for dielectric fluids would mean that only a 20-gallon spill that enters groundwater would render undrinkable 100 million gallons of public water supply. We are left at this point to guess whether that water could ever be cleaned to acceptable drinking water levels and, if so, over what time period.

Q. Vineyard Wind has indicated to the Town that it will not be able to avail itself of so-called biodegradable cooling fluids for its transformers in a timely manner to accommodate its construction schedule. Nevertheless, its filings with the Board and elsewhere continue to suggest that use of biodegradables might be a viable alternative to oil-based dielectrics. Please comment on this possibility.

A. The term "biodegradable" in context is misleading, given the concerns about the ultra-sensitivity of the receptor, the Hyannis Water system. First, the product to my understanding is still oil-based. Therefore, it is likely to be subject to the same MCP classification as other oil-based products, including Edisol and Faridol.

Secondly, "biodegradability" may create a false sense of security. If it degrades on its own but takes an extended time to do so (months or even years, given volumes involved), its release to the environment will create the same crisis for the Hyannis System.

We do not know its chemical make or its behavioral properties. In short, all of the information and testing discussed above would be required if such a product were proposed for use. Without that information, the risk parameters remain the same.

Q. Are there other wells at risk?

A. It is possible that, depending on groundwater flow, pumping, and rainfall conditions, additional Hyannis District wells could be impacted by such a release. Beyond that it is possible that Yarmouth wells which are generally down-gradient of the Hyannis wells and, depending upon the solubility and mobility of the fluid released, could also be impacted and be required to be shut down.

Knowing this information is vital. The Hyannis Water system is in precarious condition due to other sources of pollution. It has no redundancy capacity and the loss of even a single well, never mind three or more Mary Dunn wells, would create emergency conditions for the system. All of this information must be fully understood to evaluate the risks of the proposed Company installation at

Independence Park. It is also vital that the same information be fully available with respect to the Oak Street, West Barnstable, substation which is apparently Vineyard Wind's preferred alternative.

Q. What is the cost to conduct such testing?

A. Actual costs may vary depending on the depth to groundwater and thickness of the overburden deposits above bedrock at the site. Proposed work to evaluate each site would include installation of five observation wells with limited aquifer testing. This information would be incorporated into the USGS MODFLOW groundwater flow model to determine groundwater flow directions and travel times. We would also need to characterize the dielectric fluids and their properties under release conditions. This would include laboratory analysis of the fluid as well as bench testing to determine how mobile the fluid is in the subsurface as well as the behavior of the dielectric fluid with respect to the proposed containment system and leak detection system. Site evaluation costs are estimated to be around $100,000 to $125,000 per site. These costs are based on present day costs.

Q. Is containment the only solution to the risk?

A. No, it is not. Containment is the first step because the project, if approved, will be online in perhaps 24 months and there is no mitigation, short of no-build, which can be deployed to fully protect the public water supply in that timeframe.

But containment does not fully address risk. At least four additional possibilities for release come readily to mind. First, in the event of a catastrophic explosion of a transformer with projectile distribution of dielectric fluids beyond the borders of the containment vessel, the fluids could reach groundwater.

Second, in the event of a fire and release from the containment vessel, it is unclear whether the imbiber beads could or would survive the fire. If they were consumed in the fire, an uncontrolled release to groundwater would be highly likely. This possibility needs to be bench-tested.

Third, in today's extreme weather environment, it is certainly possible that sufficient rain could fall in a concentrated period of time such that the level of fluids and water could exceed the height of the containment vessel, thus releasing hazardous produce to groundwater. Last year alone, there were two rain events within about two weeks of one another that dumped more than eight (8) inches of water on the project locus. Each was the near equivalent to a 100-year, 24-hour storm event. A slow-moving hurricane or the lengthy, multi-day event such as the "no-name" storm of the 1990's could produce over-top spillage.

Fourth, dielectric fluids are periodically delivered by and then pumped out into tanker trucks for proper disposal. This creates the risk of an accident outside the containment vessel with the release directly to groundwater.

For example, in July of 1978, the South Hollow Wellfield in Truro, that supplies much of the public water to Provincetown, was closed after an underground gasoline tank leaked 3,000 gallons of fuel. The gasoline spill directly impacted the Town's water supply wells and, the South Hollow Wellfield (consisting of 8 wells) was entirely shut down from 1978 to 1980, pumped at 0.25 MGD from 1981 to 1984, and went back up to 1 MGD in 1985 to 1986. Operation of the South Hollow wellfield was impacted for over 5 years. The National Park Service (NPS) allowed a temporary well site to be established and to be used by the Town while South Hollow was off line. The NPS Cape Cod National Seashore, which consists of 68 square miles of preserved parkland, was able to develop a water supply source to sustain Provincetown and Truro during this period. Not many places on Cape Cod afford this luxury.

The only answer to these risks is to relocate the wells and treatment facilities out of harm's way upstream from the substation.

Q. How long would well relocation take?

A. The process is lengthy and could take 5 to 10 years to complete site selection, exploration, testing, permitting, and construction, depending on how many new water supply sources are required to replace the existing wells.

Q. What is the estimated cost to do so?

The Mary Dunn Wellfield consists of four water supply wells. If all four wells need to be replaced and multiple new source water supply sites may have to be developed, with no guarantee that the any of the exploration sites are a viable public water supply source. Assuming exploration is performed at five properties and water supply wells are developed at four locations, the exploration, testing and permitting may cost $5 million. Construction of four pump houses assuming pH adjustment only (excellent water quality) and a valve control station at each site, as well as connection to the existing water system (assuming 1000 feet of pipe for each station), then construction costs may be $15 million. Thus total costs may be on the order of $20 - $25 million.

If additional water treatment is required (i.e., for naturally occurring iron or manganese, which is common in New England) then an additional $10 million may be required.

These estimates are based on present day costs. According to the Associated General Contractors of America "Trump Tariffs Cause Construction Costs to Soar", they note that the cost of all goods used in construction rose 8.8 percent over the past year and that other construction inputs that rose sharply in price include diesel fuel, which rose 44.5%. These escalations in cost are not included in our estimate to replace the Mary Dunn wellfield, but must be considered if the Mary Dunn wells are replaced at a later date.

This estimate does not include the cost of land acquisition.

Q. Are there other deficiencies in the Company's information disclosure which must be supplemented?

A. Yes. We need information concerning the Company's spill response plan ashore. We need to know how often the site and transformers will be physically examined for leaks and other relevant observations. At a minimum, we need to know what equipment will be stored on site, how the station will be alarmed, who will receive notice of an alarm, how quickly an on-site response will occur, how quickly thereafter full mobilization will occur, and where that mobilization team will assemble before transiting to the substation.

Q. Vineyard Wind has requested that it be granted a waiver from the application of the Barnstable Zoning Ordinance. Does that request necessarily implicate explicit MADEP directives concerning public water supplies?

A. It does. As will be explained by other Town witnesses, the Town has a robust zoning enactment designed to protect public water supplies. That regimen is informed by MADEP guidelines and directives intended to tightly control and protect public well water sources which MADEP requires to be implemented by the local municipality as a condition for approving new well construction.

Vineyard Wind's request to avoid application of the detailed water supply protection afforded by Barnstable's Zoning Ordinance, enacted in direct response to MADEP directives, necessarily implicates and impliedly directly conflicts with MADEP statutory, regulatory, and policy requirements. Barnstable's sole-source aquifer is, by definition, its only source of potable water. A D.P.U. waiver of zoning in this respect is inconsistent with sound public policy and potentially allowing a lesser standard of protection by granting the requested zoning waiver will unnecessarily put Barnstable's water supply at a higher degree of risk.

Doing so would be inconsistent with the mandate of G.L. c. 164, § 69 J that the Company's plans are "consistent with current health, environmental protection, and resource use and development policies as adopted by the Commonwealth."

Q. Do you have a recommendation regarding dielectric fluids as relates to this permitting process?

A. Yes. The Board should not, under any circumstances, approve this project until the dielectric fluid/s proposed to be used at the Company substation are identified and until all testing protocols discussed above have been satisfactorily completed. Limited additional hearings on this finite subject would be warranted once identification and testing is complete.

Q. Does that complete your testimony?

A. Subject to rebuttal testimony, the SDEIR MEPA filing, and further discovery, it does.

Signed under the pains and penalties of perjury at Barnstable this 30th day of August, 2018.

Ann Marie Petricca, C.P.G.

Ann Marie Petricca, C.P.G.

Director of Geosciences

Background

Ms. Petricca has more than thirty years of diversified geologic experience and 25 years of environmental consulting experience in the water supply, hydrogeology, hazardous waste and solid waste fields. Her work experience has included project management, budget management, proposal preparation, management and implementation of field activities, report preparation and regulatory coordination and compliance. Technical experience and expertise includes geologic and hydrogeologic site characterization, water supply exploration and development, Massachusetts Contingency Plan (MCP) and Superfund Remedial Investigations and implementation of remedial measures, landfill assessments, geophysical techniques, and ASTM Phase I environmental assessments (domestic and international), and wastewater effluent monitoring. Field experience includes installation and sampling of monitoring wells, soil borings, test pits, and soil gas; aquifer characterization and testing; and geophysical surveys (seismic, EM, magnetometry, GPR, and borehole geophysics).

Education

- M.S., Geology, Indiana University, 1985
- B.S. Geology, Duke University, 1982

Certifications

- Certified Professional Geologist – American Institute of Professional Geologists
- 40-Hour OSHA Hazardous Waste Operations Health and Safety Training
- 8-Hour OSHA Hazardous Waste Operations Supervisors Training
- Municipal Vulnerability Preparedness Certified Provider

Professional Affiliations

- American Institute of Professional Geologists

Awards

- Winner 1995 ERM Group Excellence Award – International Category - for paper on Due Diligence Environmental Assessment of 14 Razor Blade Manufacturing facilities in India.
- Winner 1996 ERM-New England Excellence Award for Technical Excellence
- Winner 1997 ERM-New England Excellence for Client Service

New Source Water Supply Investigations and Permitting, Plymouth, MA – Ms Petricca is the Project Manager and hydrogeologist for the new source water supply development project for the Town of Plymouth. The goal of the project is to identify, test and permit a 1 million gallon per day (MGD) new source water supply. She managed a preliminary investigation phase to evaluate geology, aquifer characteristics and compliance with state public water supply requirements in Plymouth, including land uses, aquifer testing and preliminary groundwater modeling. Specific issues of concern at the water supply sites included potential impacts to cold water fisheries, fish ladder, kettle ponds, as well as numerous private water supply wells. Ms. Petricca managed the new source permitting process including Request for Site Exam and Pump Test Reports. Modeling was performed to evaluate drawdown impacts to nearby surface water features and private wells, and to delineate Zone II and Zone III boundaries.

New Source Water Supply Investigations and Permitting, Norfolk, MA – Ms Petricca is the Project Manager and hydrogeologist for the water supply new source development project for the Town of Norfolk, MA. The Town has limited redundancy for their existing water supply sources, has difficulty meeting peak day summer demands, and as a result has had to purchase water from neighboring towns. After investigations at five sites a potential shallow wellfield (minimum of three production wells located less than 50 feet apart) water supply site was identified. Exploration at the site identified six test well locations for the wellfield. An observation network was installed to evaluate pumping effects to nearby wetlands and the Charles River. A 7-day pump test with six pumping wells was conducted in June 2017, which indicated the potential for a hydraulic boundary that would control the productivity of the wellfield. Ms. Petricca worked with McLane Environmental to develop a hydrogeologic model for the wellfield and surrounding area. McLane developed an AnAqSim hydrogeologic model to evaluate the pumping capacity for the wellfield and potential impacts to the Charles River. Seasonal fluctuations in the water table can also reduce the wellfield capacity by as much as 20%. Ms. Petricca managed the new source permitting process including Request for Site Exam and Pump Test Report as well as oversight of the Environmental Notification Form (ENF) under MEPA and DEP Water Management Act Amendment.

New Source Water Supply Investigations and Permitting, Eastham, MA – Ms Petricca was the lead hydrogeologist for the water supply new source development project for the Town of Eastham. The goal of the project was to develop and permit a Town-wide municipal water supply system with average daily demand of 1 MGD and peak demand of 2.6 MGD. She managed a preliminary investigation phase to evaluate geology, aquifer characteristics and compliance with state public water supply requirements in Eastham, including land uses, aquifer testing and preliminary groundwater modeling. Specific issues of concern at the water supply sites included potential impacts to surface water streams and vernal pools and the potential for saltwater upconing or intrusion. Ms. Petricca prepared and submitted to DEP three Requests for Site Examination and Approval to Conduct Aquifer Performance Tests (for sources greater than 100,000 gallons per day) for each of the sites.

Under the second phase of this project she managed the installation of 22 observation wells, surface water piezometers and staff gauges, and four 12-inch test production wells at the three sites. Aquifer performance tests (5-8 days) were performed at each of the sites. Ms. Petricca worked with the groundwater modeling team to incorporate site data into the Nauset Lens SEAWAT groundwater model to delineate the Zone II, Zone III and sustainable yield for each site. She prepared Source Final Reports to permit four public water supply wells for the Town that are approved by DEP for a total of 3.1 MGD. This project also included coordination with the NPS-Cape Cod National Seashore, whose property abuts two of the sites.

Boy Scout Camp Wells, Wellfleet, MA – Under this project two test production wells were installed and permitted for less than 100,000 gpd. Ms. Petricca was the lead hydrogeologist for the project and provided oversight for installation of the production wells and aquifer testing. Five day pumping tests were performed on each of the wells to support future development of a source for greater than 100,000 gpd and included monitoring of pumping effects to nearby kettle ponds. Ms Petricca analyzed the field data and prepared and submitted a final report to DEP.

Freshwater – Saltwater Transition Zone Wellfield Modeling – North Union Field, Truro, MA As part of the New Source Approval process Pumping Test Report for NUF, Environmental Partners with McLane Environmental, LLC (McLane) performed groundwater quality modeling using the USGS MODFLOW and SEAWAT programs. The purpose of the modeling was to evaluate the potential for saltwater upconing at the NUF wellfield based on different pumping rates and to determine the optimal pumping rate for the NUF wellfield. An observation well monitoring program was designed to ensure the potability of the produced water by monitoring water quality in the intermediate and deep aquifer zones beneath the NUF site. The SEAWAT model was used to determine sodium and chloride concentrations at each of four intermediate and four deep monitoring wells over 100 years of pumping at two production wells. After collection of five years of water quality monitoring data at each of the observation wells, Ms. Petricca managed the development of an updated groundwater model using the site-specific water quality data. The updated model was then used to re-evaluate pumping effects on the transition zone and freshwater-saltwater interface and optimize the wellfield pumping operations.

Groundwater Flow Study – Seekonk Water District, Seekonk, MA – Ms. Petricca managed and was the lead hydrogeologist for a groundwater flow study for the Newman Avenue Wellfield, a sole source aquifer. The Wellfield supplies 80 percent of the water for the Seekonk Water District to the residents of Seekonk, MA. This project included performing a hydrogeological study of the Newman Avenue Wellfield for water supply protection, planning, and management purposes. The study included field investigations (soil borings, monitoring wells, stream piezometers, water level monitoring, and aquifer tests) to characterize the hydrogeologic properties of the overburden aquifer surrounding the Newman Avenue Wellfield and development of a groundwater flow model to examine impacts of current and potential future nitrate sources to groundwater within the capture zone of the Wellfield.

As part of this hydrogeologic study the Zone II for the wellfield was re-delineated and permitted under DEP and aquifer protection bylaws were updated.

Comprehensive Wastewater Management Plan, Wellfleet, MA
The CWMP for Wellfleet includes a unique oyster reef enhancement and spawning demonstration project for removal of nitrates from the harbor. Ms. Petricca managed the water quality monitoring program under the CWMP, including installation and sampling of monitoring wells downgradient of the downtown area, continuous water quality monitoring with a dedicated YSI, and review and evaluation of creek, harbor and oyster reef site water quality data collected by the Provincetown Center for Coastal Studies, to evaluate water quality effects from the development of the oyster reef.

Wastewater Effluent Discharge Monitoring, Provincetown, MA
Wastewater effluent from the Provincetown treatment plant is discharged at several locations along Route 6. Ms. Petricca managed the effluent discharge monitoring program, including monitoring of water levels upgradient, downgradient and within the groundwater discharge sites, water quality sampling, and DEP coordination and reporting.

Aquarion Water Tank Site, Hull, MA – Historically, two water tanks (585,000 gallons and 500,000 gallons) were located on this property to supply water storage and pressure for the residents of Hull. After tank demolition, concentrations of PCBs, lead, and other metals were detected in the soil fill material (related to the fill material, tank paint or both) that required assessment and remediation under EPA and DEP regulations. Ms. Petricca collected detailed soil quality data and supported preparation of a Phase 2/Phase 3 under the DEP MCP program. She was Project Manager for the Phase IV Remedy Implementation Plan and managed the excavation and offsite disposal of 195 tons of TSCA PCB soils and almost 1700 tons of PCB contaminated soils. The site was located in a densely residential area and extensive health and safety precautions were implemented to prevent offsite contamination. A Permanent Solution Statement was submitted for the Site in July 2016.

Stormwater MS4 Compliance, Duxbury, Hanover, and Somerset, Massachusetts

Ms. Petricca is the Project Manager for stormwater MS4 permit and compliance activities for the above Towns. Responsibilities vary by Town, and may include: permit compliance; outfall and drainage mapping; outfall inspections and sampling; facility inspections; O&M Plan development; SPCC Plan development, and annual reporting. Stormwater mapping activities vary by Town budgets and Town computer systems, but may include: GPS locating, mapping structures, outfalls, piping, etc.; and using ArcMap for publishing to the Town's GIS website.

Ann Marie Petricca, C.P.G.

Director of Geosciences

Burgess Brothers Superfund Site, Bennington, Vermont –The Burgess Site is a former private landfill that accepted battery waste. Contaminants of concern include chlorinated solvents and metals in groundwater, surface water and soils. Ms. Petricca has been the lead hydrogeologist for this Site since 1994 and managed the development and implementation of the Remedial Investigation (RI), Supplemental RI, Long Term Monitoring, and Feasibility Study (FS). She prepared groundwater, surface water and sediment portions of the Demonstration of Compliance Plan, Post-Closure Environmental Monitoring Plan, and Quality Assurance Project Plan, and assisted with preparation of the Operation and Maintenance Plan for the SVE/air sparge system and landfill cap. She has managed post-closure environmental monitoring, including ambient air and passive gas vent sampling, groundwater, surface water and sediment sampling. In addition, Ms Petricca prepared and negotiated a Groundwater Reclassification Petition with the State of Vermont to downgrade the designation of the aquifer to a non-potable status.

Ms. Petricca managed and conducted additional assessment activities to address changes in the groundwater contaminant plume since capping and closure of the landfill, development of a groundwater flow model, and mass flux dilution calculations. EPA approved a Supplemental Focused FS in 2011 to address the groundwater contaminant plume. Ms. Petricca developed and managed a Pre-Design Investigation to support installation of either a permeable reaction barrier or collection trench to mitigate the groundwater contaminant plume. This collection trench system was installed at the site in 2013 - 2014. Ms. Petricca is managing the long term monitoring program for the site.